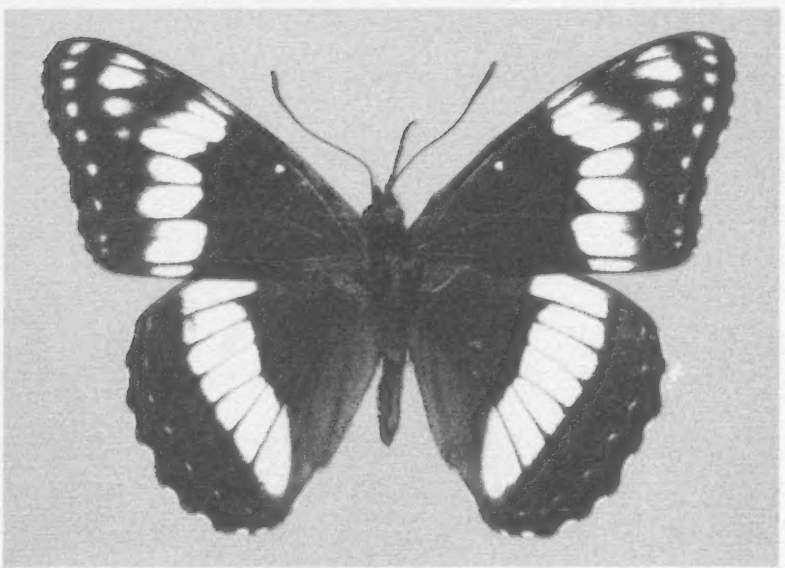
COSEWIC
Assessment and Status Report

on the

Weidemeyer's Admiral
Limenitis weidemeyerii

in Canada



SPECIAL CONCERN
2012

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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COSEWIC would like to acknowledge Robert Foster and Allan Harris for writing the update status report on Weidemeyer's Admiral *Limenitis weidermeyerii* in Canada, prepared under contract with Environment Canada. This report was overseen by Laurence Packer, Co-chair of the COSEWIC Arthropods Specialist Subcommittee.

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Weidemeyer's Admiral — Upper view of male Weidemeyer's Admiral. Photo taken by Norbert Kondla.

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COSEWIC
Assessment Summary

Assessment Summary – May 2012

Common name
Weidemeyer's Admiral

Scientific name
Limenitis weidemeyerii

Status
Special Concern

Reason for designation
This large butterfly has a small Canadian population and is restricted to valleys and prairie coulees of southern Alberta. The threat of invasive Russian Olive and Saltcedar that outcompete the butterfly's larval host plant is predicted to increase.

Occurrence
Alberta

Status history
Designated Special Concern in May 2000. Status re-examined and confirmed in May 2012.

COSEWIC
Executive Summary

Weidemeyer's Admiral
Limenitis weidemeyerii

Wildlife Species Description and Significance

Weidemeyer's Admiral is a relatively large, boldly patterned black and white butterfly. It has more white on its hind wing underside and reduced orange markings than the closely related Lorquin's and White Admirals. As with related species, the larvae resemble bird droppings. The species represents a southern biogeographical element at the northern limit of its range along the Milk River, and is an important model for the study of speciation and mimicry.

Distribution

Weidemeyer's Admiral is found in western North America from southern Alberta to northern Mexico. In Canada, it is known from seven sites in the Milk River and Lost River area along the Alberta-Montana border. Targeted searches for this species have been conducted in 2004 and 2011 but large areas of potentially suitable habitat have not been surveyed and additional occurrences may yet be found.

Habitat

In Canada, Weidemeyer's Admiral is found along valley bottoms, ravines, and coulees along the Milk and Lost rivers where the larval host plant, Saskatoon, is found. Cottonwood and other deciduous trees and shrubs provide shelter and perch sites for adults, and structural support for their major nectar source, Western Clematis which is a vine. Weidemeyer's Admiral will also use small patches of Chokecherry and Saskatoon in ravines and coulees some distance from the nearest treed riparian habitats.

Biology

All Canadian populations appear to have one generation per year. Saskatoon is the only confirmed larval host plant in Canada, although Chokecherry, willows and other shrubs might be used. Late instar larvae overwinter in a rolled-up leaf and emerge in the spring to continue feeding. In Canada, the adult flight period is from early June through late July.

Population Sizes and Trends

Total population size and trend are unknown for Canadian sites although it is expected that the species has a total population of at most a few thousand in Canada. Since it was first reported from Alberta in the 1970s, there has been a slow increase in the number of confirmed Canadian sites due to increased survey efforts (rather than range expansion). It is relatively widespread and abundant in suitable habitat across much of its range in the western United States.

Threats and Limiting Factors

Invasive species, particularly Russian Olive and Saltcedar, may soon change the ecology of woody riparian communities to the detriment of Weidemeyer's Admiral. Overgrazing by livestock could be a potential threat by reducing habitat quality and incidental ingestion or trampling of larvae.

Protection, Status, and Ranks

Weidemeyer's Admiral is listed as *Special Concern* by Canada's *Species at Risk Act* as well as Alberta's *Wildlife Act*. It is ranked by NatureServe as critically imperiled (S1) in Alberta but secure globally (G5).

TECHNICAL SUMMARY

Limenitis weidemeyerii
Weidemeyer's Admiral — Amiral de Weidemeyer
Range of occurrence in Canada: Alberta

Demographic Information

Generation time	1 yr
Is there an inferred decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	NA
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	Population trend is unknown
Are there extreme fluctuations in number of mature individuals?	Unknown

Extent and Occupancy Information

Estimated extent of occurrence	1081 km²
Index of area of occupancy (IAO)	164 km²
Is the total population severely fragmented?	No
Number of locations*	7
Is there a continuing decline in extent of occurrence?	Probably not
Is there a continuing decline in index of area of occupancy?	Probably not
Is there a continuing decline in number of populations?	Probably not
Is there a continuing decline in number of locations*?	Probably not
Is there a continuing decline in habitat?	Probably not
Are there extreme fluctuations in number of populations?	Probably not
Are there extreme fluctuations in number of locations*?	Probably not
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Not available	
Total	Estimated at up to 3200

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Unknown

Threats (actual or imminent, to populations or habitats)

Imminent threat to larval host plants from invasive species, Russian Olive in particular, although this species is being actively suppressed it is a very aggressive invader and once established in the butterfly's habitat is expected to have a large negative impact.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? Apparently stable but under threat from invasive species	
Is immigration known or possible?	Possible only if US populations remain healthy
Would immigrants be adapted to survive in Canada?	Possibly
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	Possibly, but only if habitat remains suitable and habitat loss through invasive plants is the main threat

Current Status

COSEWIC: Special Concern (2012)

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Special Concern	Not applicable
Reasons for designation: This large butterfly has a small Canadian population and is restricted to valleys and prairie coulees of southern Alberta. The threat of invasive Russian Olive and Saltcedar that outcompete the butterfly's larval host plant is predicted to increase.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. No evidence of decline.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. Although EO and IAO are below thresholds, and the number of locations is likely below threshold for Threatened, there is no evidence for decline.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Although estimates of population size are less than the threshold for Threatened, the accuracy of the estimates is considered low and there is no evidence for decline.
Criterion D (Very Small or Restricted Total Population): Not applicable. Population size is unknown and number of localities and IAO are above thresholds.
Criterion E (Quantitative Analysis): Not performed.

PREFACE

This species was assessed as *Special Concern* by COSEWIC in 2000 and as *May be at Risk* (equivalent to *Special Concern*) in 2000 in Alberta (Government of Alberta 2000).

Additional surveys for Weidemeyer's Admiral were conducted in southern Alberta in 2004 by Norbert Kondla for preparation of the provincial status report in 2005. One new site was discovered west of previously known sites and admirals were observed using smaller habitat patches than previously documented.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2012)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Weidemeyer's Admiral

Limenitis weidemeyerii

in Canada

2012

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Weidemeyer's Admiral, *Limenitis weidemeyerii* W.H. Edwards, 1862, is a member of the brush-footed butterflies (Lepidoptera: Nymphalidae). Some authors (e.g., Miller and Brown 1981), consider North American admirals distinct from Palaearctic *Limenitis* and place them in a separate genus, *Basilarchia*. Although there is some structural and genetic evidence to support this (e.g., Willmott 2003; Mullen 2006), most recent checklists retain North American representatives as *Limenitis* (NABA 2001; Opler and Warren 2003, Pelham 2008; ITIS 2010).

Weidemeyer's Admiral has long been known to hybridize with Lorquin's Admiral, *Limenitis lorquini* (Boisduval, 1852) where they meet in the western Great Basin (e.g., Remington 1968). Based upon an estimate of gene flow derived from allozyme frequencies, Porter (1990) argued that they should be treated as geographic morphs of the same species. However, Boyd *et al.* (2000) argued that species level designations should be retained because the zone of hybridization is narrow and the deficit of hybrid females in parts of the hybrid zone suggests there are at least partial barriers to gene flow. More recent mtDNA evidence (Mullen 2006) indicates that Weidemeyer's Admiral and Lorquin's Admiral are sister species that, despite occasional hybridization, are able to maintain the distinctiveness of their respective wing patterns. Lorquin's Admirals are mimics of California Sister (*Adelpha bredowii*), and the origin of mimicry within this lineage may contribute to current barriers to gene exchange for regions of the genome controlling wing pattern (Mullen 2006). Some Canadian Weidemeyer's Admiral individuals have also been reported having hybrid characters with the White Admiral, *L. arthemis* Drury (Pinel and Kondla 1985; Pike 1987).

There are six recognized subspecies of the Weidemeyer's Admiral (Edwards 1862; Barnes and McDunnough 1912; Barnes and Benjamin 1924; Brown 1960; Perkins and Perkins 1967; Austin and Mullins 1984), of which only *L. w. oberfoelli* F. Brown, 1960 occurs in Canada. Montana is regarded as an area of intergradation between subspecies of Weidemeyer's Admiral (Perkins and Perkins 1967). Weidemeyer's Admiral populations in Montana immediately adjacent to Canadian populations appear to be *L. w. oberfoelli*, although there is also some evidence of introgression with *L. w. latifascia* / *L. w. weidemeyerii* (Kondla 2000, 2005). Compared to *L. w. weidemeyeri*, the red submarginal spots on the dorsal hind wing are more prominent and the ventral ground colour is lighter in *L. w. oberfoelli* (Brown 1960; Perkins and Perkins 1967). The postmedian white band is narrower in *L. w. oberfoelli* than *L. w. latisfacia*. However, individuals referable to *L. w. oberfoelli* do occasionally turn up in *L. w. latisfacia* populations (Stout pers. comm. 2010).

Morphological Description

Weidemeyer's Admiral is a relatively large (wingspan 55 to 72 mm) butterfly with a bold white band on both surfaces of the fore and hind wings (Scott 1986a) (Figure 1). Weidemeyer's Admiral has extensive greyish-white markings on the underside of the hind wings rather than a brownish base colour as in Lorquin's Admiral and the White Admiral (*L. arthemis*), which are also found in southern Alberta (Bird *et al.* 1995). Lorquin's Admiral also has a distinctive reddish apical patch on the dorsal (and sometimes ventral) fore wing that is lacking in the Weidemeyer's Admiral. In Alberta, Weidemeyer's Admiral has small white spots along the margin, and sympatric White Admirals have more distinct reddish submarginal spots on the upper hind wing (Bird *et al.* 1995; Layberry *et al.* 1998).

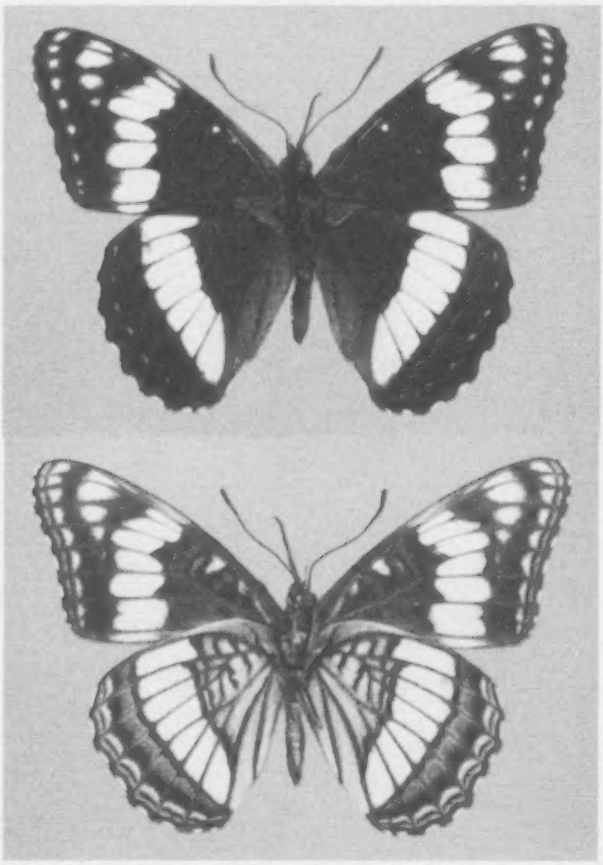

Figure 1. Upper and lower views of male Weidemeyer's Admiral from North Pinhorn Provincial Grazing Reserve, July 1 2004 (Norbert Kondla photos).

The early stages of the Weidemeyer's Admiral have not been found in Canada (Layberry *et al.* 1998), but have been described by Scott (1986a) from elsewhere in its range. The eggs are round and greyish-green (Figure 2). The larvae are similar to those of other *Limenitis* species and resemble bird droppings. They are either olive-green with a yellow-tan thorax or greyish and mottled with grey and white patches (Figure 3). Figure 4 shows a hibernaculum of a larva. The abdomen has a whitish or yellowish-tan saddle on the middle and a whitish lateral band. The head is red-brown, with small tubercles on top. Pupae are blackish-brown with a black streak extending obliquely back from the saddle horn.

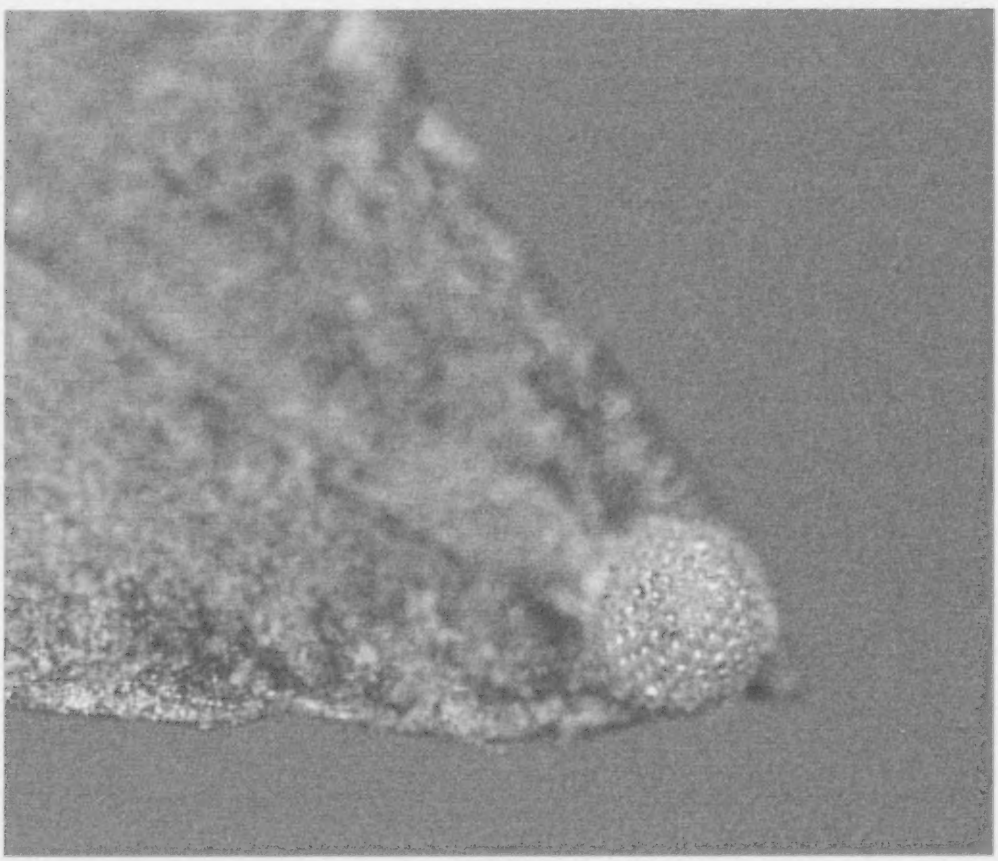

Figure 2. Egg of Weidemeyer's Admiral (*Limenitis weidemeyerii latifascia*) from Utah (Todd Stout photo).

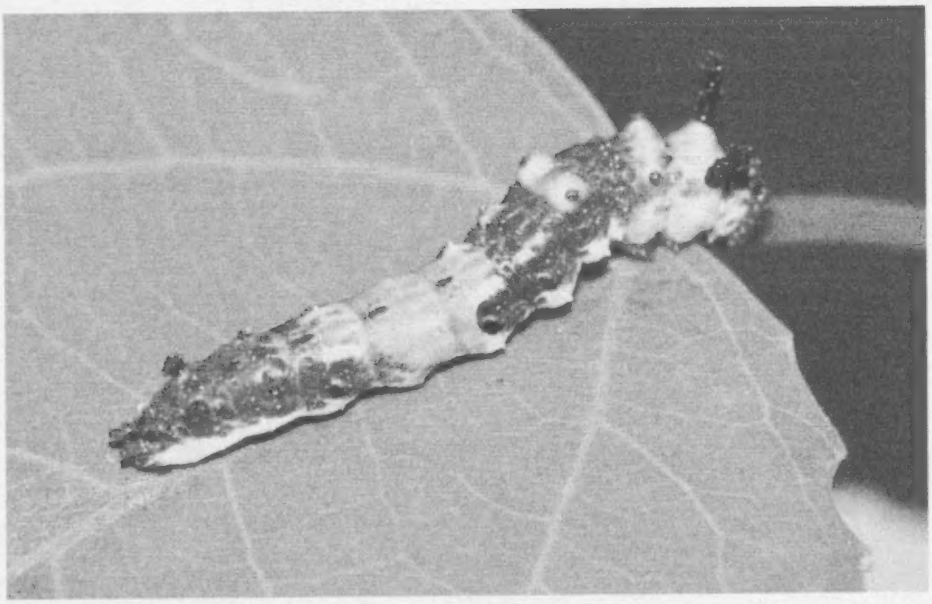

Figure 3. Fifth instar larvae of Weidemeyer's Admiral (*Limenitis weidemeyerii latifascia*) from Utah (Todd Stout photo).

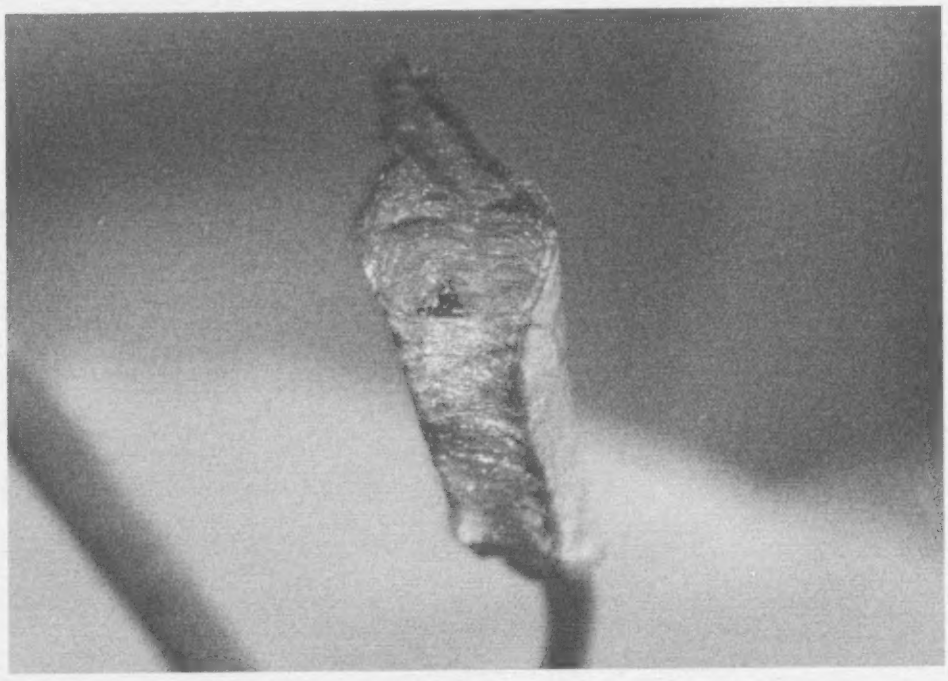

Figure 4. Hibernaculum of Weidemeyer's Admiral (*Limenitis weidemeyerii latifascia*) from Utah (Todd Stout photo).

Population Spatial Structure and Variability

No genetic studies have been conducted for Weidemeyer's Admiral in Canada. Although it may have two main metapopulations along the Milk River (Kondla 2000), they are likely not discrete given the species' dispersal capability and the relatively continuous distribution of potential habitat along the Milk River and associated coulees.

Mullen *et al.* (2008) have used mtDNA to examine hybridization in *L. arthemis*, and used Weidemeyer's Admiral specimens from Colorado as an outgroup for their analyses. The Barcode of Life Data Systems (BOLD) system has also described the DNA-barcode for two specimens of Weidemeyer's Admiral (Ratnasingham and Hebert 2007).

Designatable Units

No designatable units are proposed because only one subspecies is known from Canada and it occurs in only one ecoregion.

Special Significance

The Weidemeyer's Admiral and other *Limenitis* species are particularly significant for studying wing pattern evolution and speciation because the genus is unusual among temperate butterflies in that mimicry has evolved multiple times and hybridization is frequent between wing pattern forms (Mullen et al. 2008).

Weidemeyer's Admiral is emblematic of a southern biogeographic element that reaches its northern limit in southern Alberta. The valley slopes and badlands of the Milk River and its tributaries provide particularly diverse habitats for a number of Lepidoptera species that are found nowhere else in Canada (Pohl *et al.* 2010), and have been identified as one of five hot spots for butterfly conservation in Alberta and British Columbia (Kondla *et al.* 2000). The Sage Creek-Milk River area has been identified as a grassland priority conservation area within North America's central grasslands due to the high concentration of imperilled species (CEC and TNC 2005).

Finally, Weidemeyer's Admiral is potentially an indicator of high quality tree- and shrub-dominated habitat patches that are highly restricted in an arid grassland environment (Kondla 2000).

DISTRIBUTION

Global Range

Weidemeyer's Admiral is widely distributed in the western interior of North America, ranging from southeastern Alberta and western Texas west to east-central California and southwestern Oregon (Scott 1986a; Lepidopterists' Society 2010). Figure 5 shows the approximate North American (i.e., global) range of the species. Weidemeyer's Admiral has recently been reported from north Coahuila, Mexico (Warren *et al.* 2010). Extra-limital records, presumably vagrants, have also been recorded from Kansas, Oklahoma, and Washington (Table 1).

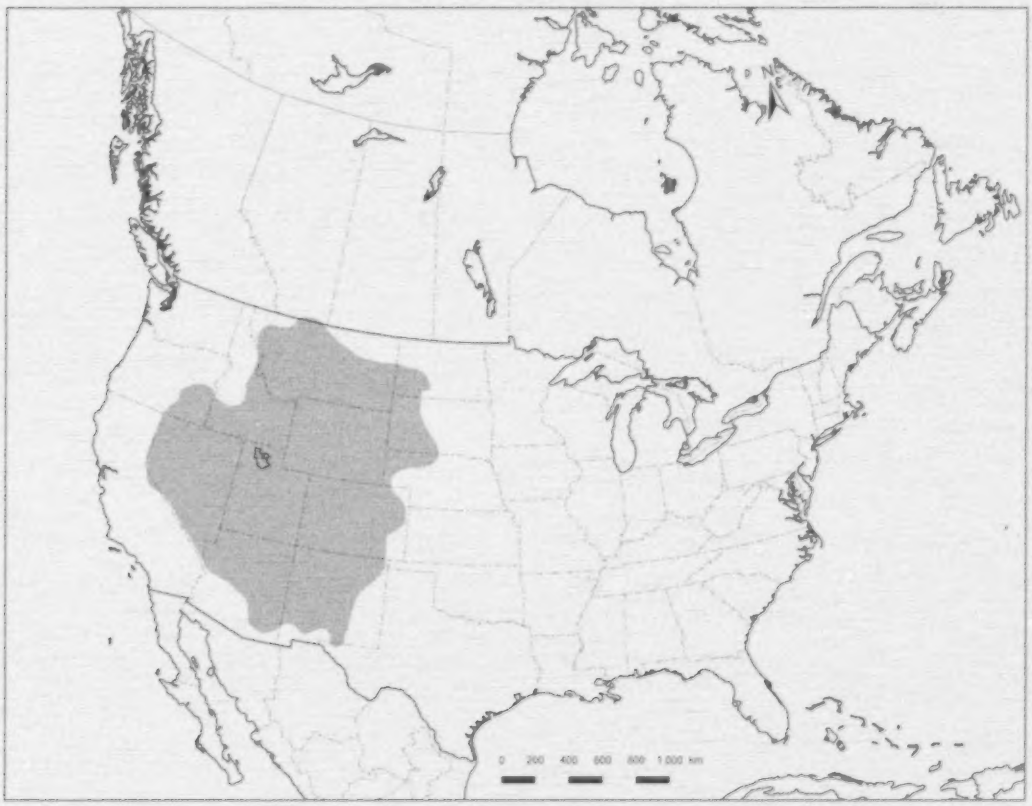

Figure 5. Global range of Weidemeyer's Admiral (based primarily on Scott 1986a; Kondla 2005; Opler *et al.* 2010).

Table 1. Provincial and state ranks for Weidemeyer's Admiral (NatureServe 2010) and notes on distribution.

Province / State	S-Rank	Notes
Alberta	S1	extreme southeast corner of province only
Arizona	SNR/SU	south to the Chiricahua Mountains; absent in southwest part of state (GBIF 2010; Opler *et al.* 2010)
California	S1	Mono County only (GBIF 2010; Opler *et al.* 2010)
Colorado	S5	widespread in suitable habitat
Idaho	SNR	widespread except northwest portion of state (Opler *et al.* 2010)
Kansas	SNR/SU	although there may be some roughly suitable habitat along the Republican River in the northwest corner of the state, there are no confirmed records (Adams pers. comm. 2010)
Montana	S5	few recent records, but fairly widespread in state, state rank largely based in G-rank (Maxell pers. comm. 2010)
Nebraska	S3	several counties in the western part of the state
Nevada	S2S3	*L. w. nevadae* subspecies (NNHP 2010)
New Mexico	SNR	not tracked
North Dakota	SNR/SU	southwestern portion of state (Opler *et al.* 2010)
Oklahoma	SNR	very uncommon stray with no evidence of a breeding population (J. Nelson fide Bergey, pers. comm. 2010).
Oregon	SNR	local and restricted to riparian cottonwood-willow areas in Harney and Malheur counties in the eastern portion of the state (Ross pers. comm. 2010)
South Dakota	SNR/SU	western portion of state (Backlund pers. comm. 2010)
Texas	SNR/SU	known from one record in El Paso County in extreme western part of state (Quinn pers. comm. 2010).
Utah	SNR	would likely be ranked S4S5 based on known occurrences (Oliver pers. comm. 2010)
Washington	SNR	not tracked (Fleckenstein pers. comm. 2010) and not present in the state although there is a 1982 specimen from Mount Baker at Yale Peabody Museum (Pelham pers. comm. 2010)
Wyoming	SNR	not ranked but records for 10 of 23 counties (Tronstad pers. comm. 2010)

The global maximum extent of occurrence is approximately 2.3 million km^2. Detailed distribution within this range has not been documented but is certainly patchy and discontinuous reflecting the occurrence of suitable habitat. The subspecies *L. w. oberfoelli* is confined to the northeastern fringe of the species' global range, which represents approximately 20% of the total area (Kondla 2005). Less than 0.1% of the mapped global range for the species and less than 0.5% of the subspecies' range is in Canada.

Canadian Range

The first published record of the Weidemeyer's Admiral for Canada was by Gregory (1975), on the basis of a specimen collected by Gamble Geddes in 1883, presumably in the Crowsnest Pass area of extreme southwestern Alberta. The validity of this record has been questioned (Smith and Bird 1977b) and the species has not subsequently been found in southwestern Alberta.

The first contemporary record of Weidemeyer's Admiral in Canada was from the lower Milk River in southeastern Alberta (Smith and Bird 1977a). All confirmed records are from an approximately 80 km corridor along the lower Milk River, tributary coulees, and the extreme lower Lost River valley (Smith and Bird 1977a,b; Thormin *et al.* 1980; Pinel and Kondla 1985; Pike 1987; Kondla 1998, 2000, 2004; ACIMS 2010). This area falls completely within the Northern Fescue and Mixedgrass subregions of the Grassland Natural Region of Alberta (NRC 2006).

There are two main areas known for Weidemeyer's Admiral in Canada, one centred on Writing-on-Stone Provincial Park and another approximately 60 km east on the Pinhorn Provincial Grazing Reserve (Figure 6). Three populations in the eastern metapopulation and four in the western metapopulation are considered likely (Kondla 2005). There may be some exchange of adults between the two metapopulations but no movement studies between or within metapopulations have been undertaken (Kondla 2005). Based on COSEWIC criteria, these seven sites may be considered as representing seven locations, because a single threatening event is unlikely to affect all sites. Habitat degradation by invasive non-native plants, the most imminent and likely threat, would act gradually and with variable timing and manner depending on the site characteristics. It appears the Lost River occurrence was erroneously depicted in Kondla (2000) in Milk River Natural Area but is actually located approximately 16 km to the east in Onefour Heritage Rangeland Natural Area. No specimen or record could be found to confirm its presence in Milk River Natural Area.

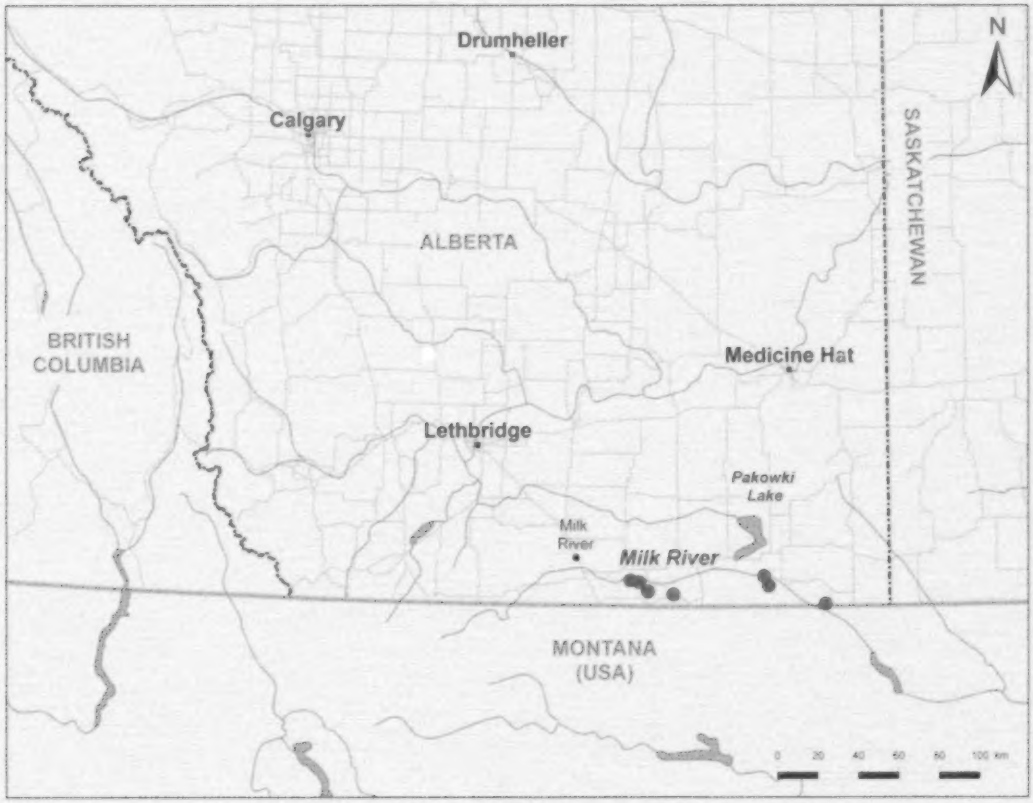

Figure 6. Canadian range of Weidemeyer's Admiral.

Bird *et al.* (1995) refer to the range of Weidemeyer's Admiral extending into southern British Columbia, but Kondla (2005) could not find any supporting evidence, and it does not appear on the checklist of Lepidoptera in British Columbia (Cannings and Scudder 2007). It may be the result of the vague locality description of "Crow Nest" on the 1883 Geddes specimen.

Layberry *et al.* (1998) provide details of a 1960 specimen of *L. w. oberfoeilli* from Rainy River, Ontario. This record is approximately 700 km from the nearest known populations in southwestern North Dakota, and is unlikely to represent a breeding population (there are no other records of Weidemeyer's Admiral from the area).

The maximum extent of occurrence (EO) in Canada based on the species' known range encompasses 1081 km^2. The area of occupancy is a very small proportion of this due to the highly fragmented and very limited extent of woody vegetation within the known range. The maximum index of area of occupancy (IAO) encompasses 164 km^2 (using a 2 km x 2 km grid) but only 34 km^2 is actually mapped as Weidemeyer's Admiral habitat based on Alberta Conservation Information Management System (ACIMS) element occurrence data. The total area of habitat occupied by larval food plants is likely less than 1 km^2 (Kondla 2005). Habitat suitability modeling for the Milk River area by Taylor (2004, Figure 7), based on the cover of woody species and slope, probably overestimates the amount of potential habitat for Weidemeyer's Admiral in Alberta due to coarseness of mapped vegetation polygons and the inclusion of shrubs that are not larval host species (Kondla 2005).

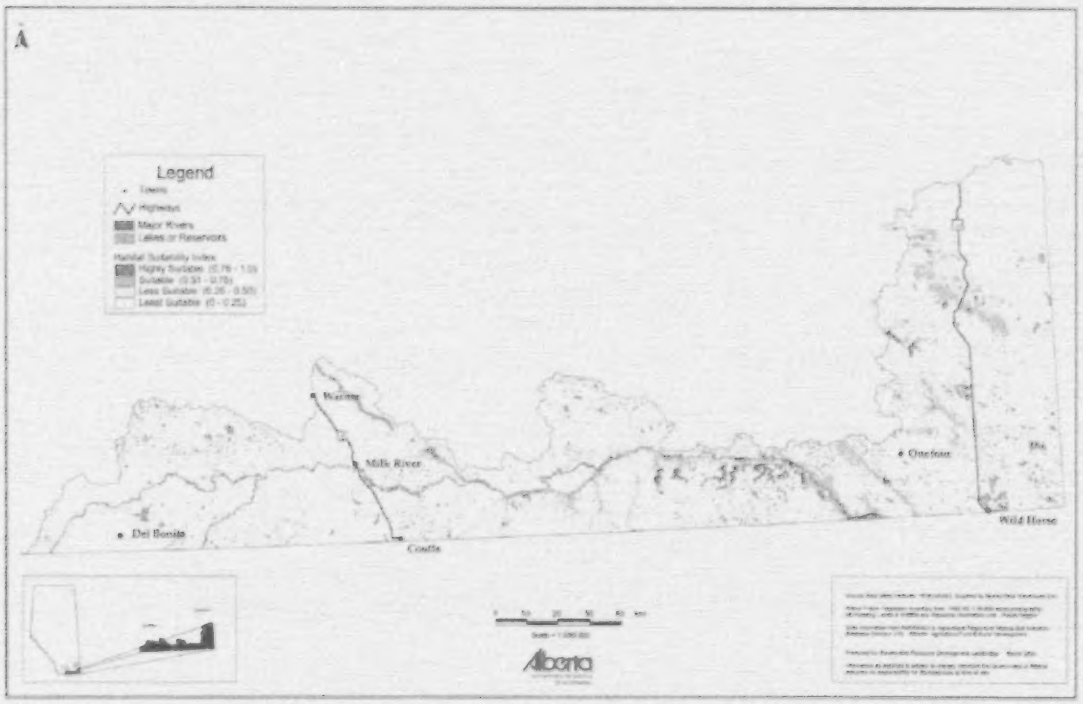

Figure 7. Potential habitat for Weidemeyer's Admiral in the Milk River Basin based on habitat suitability index (HIS) modeling (Taylor 2004). Red areas were modeled as highly suitable and orange areas were suitable.

Search Effort

Butterfly surveys in the Milk River area have been conducted since the mid 1970s by a number of lepidopterists, notably E. Pike, N. Kondla, H. Pinel, W. Smith, T. Thormin and C. Wallis (Kondla 2000). In Alberta, only a few people have collected limited numbers of this butterfly over a 25-year period and only a fraction of suitable habitat has been visited, in part due to relatively difficult access (Kondla 2000). Kondla (2004) surveyed 44 known and potential sites in the Milk River area for Weidemeyer's Admiral in 2004.

Targeted surveys were conducted for Weidemeyer's Admiral June 28 to July 5, 2011 along the Milk River (Vujnovic pers. comm. 2012). Approximately 44 person-hours of surveys were conducted along the 9 km west of Verdigris Coulee, the westernmost known occurrence (no admirals were observed). Twelve Weidemeyer's Admirals were found during approximately 109 person-hours and 13 km of survey in Police Coulee and Davis Coulee. For the latter, six butterflies were observed and are the first documentation for the species, despite its close proximity to Police Coulee and Writing-On-Stone Provincial Park headquarters. Otherwise, no targeted surveys for this species have been conducted since 2004. The absence of adults observed during a survey does not confirm absence, because presence and activity of adults is extremely dependent on conditions during the survey and seasonality of flights. Survey conditions were good during the 2004 and 2011 surveys.

Current information underestimates the number of butterflies expected from Canada, and the full distribution of this species in Canada is not yet known (Kondla 2004). Additional survey effort is needed to determine if the apparent distributional gap is real or an artifact of sampling. Most gaps in the known distribution shown in Figure 6 have not been adequately sampled to rule out the presence of Weidemeyer's Admiral in suitable habitat. Potential habitat outside the known range (e.g., north of Onefour, near Warner) identified by habitat suitability index (HSI) modeling should also be surveyed (Taylor 2004).

HABITAT

Habitat Requirements

Weidemeyer's Admiral is widely reported to occupy woody riparian habitats at mid-elevations (Austin and Murphy 1987; Bird *et al.* 1995), which occur along the Milk River and its subsidiary drainages. Valley bottoms, ravines, and coulees provide the topographic and edaphic conditions required by the admiral's food plants, and are also used by adults as flight corridors between breeding habitat patches (Kondla 2005). Suitable Weidemeyer's Admiral habitat includes taller deciduous shrubs or trees that serve as larval food plants and elevated perches for mate-locating behaviour by males, as well as moisture and nectar sources for adults. Shrub patches and riparian trees in coulees and valleys provide shelter from strong prairie winds and facilitate mate-locating behaviour (Kondla 2005).

In Canada, Weidemeyer's Admiral is typically seen in association with deciduous trees and shrubby areas in river valleys, seepage sites and smaller stream valleys (i.e., 'coulees') (Kondla 2000) (Figure 8, Figure 9). Cottonwood (*Populus sargentii*), hybrid poplar (*Populus* spp.), Saskatoon (*Amelanchier alnifolia*), Western Clematis (*Clematis ligusticifolia*), and Thorny Buffaloberry (*Shepherdia argentea*) were present at all Milk River sites surveyed by Pike (1987). Saskatoon is the only confirmed larval food plant in Alberta (Pike 1987). Clematis is the major nectar source for the adults, while Cottonwoods provide shelter and Thorny Buffaloberry provides structure for the clematis to grow upon. Kondla did not find admirals associated with large stands of willow (*Salix* spp.), although Porter (1989) found occasional use of willow thicket edges in New Mexico.

Figure 8. Confirmed Weidemeyer's Admiral habitat at Police Coulee in Writing-On-Stone Provincial Park, Alberta in 15-1-13W4 (Kondla 2004).

Figure 9. Weidemeyer's Admiral habitat at south Pinhorn Provincial Grazing Reserve (near 12U 0512455, 5436565) (Kondla 2004).

Recent survey effort also found Weidemeyer's Admiral in small patches of Chokecherry (*Prunus virginiana*) and Saskatoon in ravines and coulees some distance from the nearest treed riparian habitats (Kondla 2005) (Figure 10). This is fairly consistent with the use of treed and shrubby riparian habitat in nearby Montana (Kondla 2005) and the badlands of North Dakota (Royer 2003).

Figure 10. Small ravine (12U 0511183, 5436613) with very small shrub patch where an adult Weidemeyer's Admiral was observed perching and patrolling (Kondla 2004).

Males have been observed engaging in perching/patrolling mate-locating behaviour at even extremely small patches (<5 m^2) of Chokecherry and Saskatoon (Kondla 2005). Although such small patches are insufficient to sustain a population, coulees or ravines with multiple small shrub patches constitute Weidemeyer's Admiral habitat.

Habitat Trends

Trends in Weidemeyer's Admiral habitat availability and quality are unknown. The abundance and distribution of suitable shrubby riparian habitat likely has responded to changes in natural disturbance regimes due to European settlement, particularly as a result of the replacement of Bison (*Bison bison*) by livestock and suppression of fire, and other human impacts on the landscape. Localized loss or degradation of Weidemeyer's Admiral habitat from construction of infrastructure for oil and gas production, ranching, and recreation may have occurred but the direct impacts of these disturbances are undocumented.

Russian Olive and (*Eleagnus angustifolia*) or Tamarisk (*Tamarix ramosissima*, *T. chinensis*, and their hybrids) are invasive plants that are expected to have a strongly negative impact upon the ecology of the butterfly's habitat in general and its larval hostplant in particular (see **THREATS AND LIMITING FACTORS).**

Habitat patches within the known range of Weidemeyer's Admiral in Alberta appear to be currently stable, and habitat fragmentation is likely not a major threat for Weidemeyer's Admiral because their habitat is naturally fragmented and the adults are capable of flying hundreds of metres, and likely farther, between patches of breeding habitat (Kondla 2005).

BIOLOGY

Life Cycle and Reproduction

Eggs are laid singly on the upperside of host leaf tips, often on young plants (Scott 1986a). The number of eggs laid in the wild is unknown, but captive rearing has resulted in more than 100 eggs being laid by a single female (Kondla 2005). Oviposition has been observed on a Saskatoon bush near Writing-On-Stone Provincial Park (Pike 1987), and elsewhere in the species' range. Other reported food plants from elsewhere in the species' range include willows (e.g., *Salix amygdaloides, S. exigua*), poplars (e.g., *Populus tremuloides*, *P. angustifolia*), serviceberries (e.g., *Amelanchier utahensis*), and Chokecherry (Scott 1986b, 1992; Stout 2010). Adults take nutrients and moisture from mud, carrion, flower nectar (e.g., Western Clematis in Alberta), and tree sap (Scott 1986a .Pike 1987; Rosenberg 1989a).

Weidemeyer's Admiral has a single generation per year, with the third instar larva overwintering in a hibernaculum made of a rolled up leaf (Scott 1986a) (Figure 4). The hibernaculum is attached with silk to the stem of the host shrub, where it remains through the winter, so the larva can easily resume feeding the following spring (Stout 2010). Spring emergence of larvae from the hibernaculum is apparently cued by average daily temperature and photoperiod, as well as phenology of the host plant (Stout pers. comm. 2010). The pupal stage usually lasts for 8-14 days depending on temperature (Stout pers. comm. 2010). Alberta populations appear to be exclusively

univoltine (Bird *et al.* 1995), although two flights have been recorded elsewhere in its range (Scott 1986b). Reported flight dates in Alberta extend from June 7 to July 22, with most flight activity occurring in late June and early July (Bird *et al.* 1995).

The Weidemeyer's Admiral uses a combination of perching and patrolling behaviour to locate and acquire mates (Scott 1975). Males defend territories and engage in aerial contest behaviour (Rosenberg 1989a; Rosenberg and Renquist 1991). In the Writing-On-Stone Provincial Park area, males appear to frequently engage in the patrolling type of mate locating behaviour (Pike 1987). Males tend to patrol early in the day and later settle onto perch sites (Porter 1989). Females are less often seen, spending much of their time in shrubs, and when seen are often flying along the long axis of suitable habitat in search of oviposition sites (Pike 1987; Porter 1989; Kondla 2005).

Physiology and Adaptability

There is little published information on the physiology and adaptability of Weidemeyer's Admiral. They are presumably fairly adaptable, being widely distributed from the Upper Sonoran to the Canadian Zone in wooded mountain canyons, streamsides, and suburbs (Scott 1986a). Host plants include several genera and multiple species of at least two families (Salicaceae and Rosaceae) (Scott 1986b). At the northern limits of their distribution in Canada, they are likely near their physiological limit in terms of cold tolerance. Other subspecies of Weidemeyer's Admiral (*L. w. latifascia*) have been successfully reared in captivity in Utah (Stout 2010) and would likely survive if released into the wild.

Dispersal

Although Rosenberg (1989a) considered Weidemeyer's Admiral to be a "strong flier", a mark-recapture study of four populations at two geographically separate sites in Colorado found that adults were relatively sedentary (Rosenberg 1989b). Adults of both sexes traveled a mean of only 166 m during the flight season, with a maximum of 2850 m. There was little interchange of individuals and significant allele frequency differences in some discrete populations only 4 km apart. Territoriality was thought to contribute to the lack of movement between populations. Nonetheless,in Alberta, adults easily fly between patches of breeding habitat (Kondla 2005). Weidemeyer's Admirals use ravines and coulees as flight corridors, and although they have not been observed flying over open prairie in Alberta, their distribution suggests that they occasionally do cross open habitats (Kondla 2005).

Interspecific Interactions

There is very little information on interspecific interactions of Weidemeyer's Admiral. As it is non-mimetic, adults are likely eaten by a range of birds, and larval predators probably include a range of insects, arachnids, and vertebrates. Browsing cattle and deer can dislodge larvae from host plants and cause incidental mortality of immature stages through browsing of host plants (Kondla 2005).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

No mark-release-recapture studies or transect counts have ever been undertaken on the Milk River admirals. Rough population estimates have been made by extrapolating from abundance of adults per linear estimates of riverine valley habitat in Canada (see below). Pike (pers. comm. in Lancaster 1988) estimated there were 50–100 adult individuals in Writing-On-Stone Provincial Park, with a maximum of 17 found in one day during 5 hours of searching along 2 miles (3.2 km) of Police Coulee. The extrapolation may be an underestimate given the amount of apparently suitable habitat in the park. No population surveys have been undertaken since 2004 and none have comprehensively estimated the number of adults.

Abundance

Kondla (2000) estimated a maximum total adult population of Weidemeyer's Admiral in Alberta of 1800 to 3200 individuals. This was based on an extrapolation of Pike's 1987 estimate of 30-50 adults per linear kilometer of habitat, and Kondla's rough estimate of 60 to 65 km of riparian habitat within its known Alberta range based on maps and air photos. This assumed all apparently suitable habitat patches within the known range were occupied, although they had not been inventoried. This is a generous assumption and 3200 may be an upper limit to the actual population of this species in Canada.

Rosenberg (1989b) performed population studies on this species in Montana. However, he did not state area of habitat studied and this makes extrapolation to the Alberta populations problematic.

More definitive population estimates cannot be provided without substantial additional fieldwork over multiple years with variable weather conditions (Kondla 2005).

Fluctuations and Trends

Anecdotal information suggests that populations are largely stable. Pike (pers. comm. in Kondla 2000) observed that populations in Township 2, Range 14 appeared to be lower in recent years, perhaps due to increased cattle grazing. However, there is insufficient historical information to allow even an estimate of population trends over time for Weidemeyer's Admiral for this or other Canadian populations (Kondla 2005). The total number of known populations has increased over time due to the discovery of new sites that had not been surveyed or where it had previously been undetected.

Rescue Effect

Weidemeyer's Admirals are known from Sweetgrass Hills of Montana, which are approximately 48 km south of known Alberta populations. The Sweetgrass Hills are directly connected by coulees to Writing-On-Stone Provincial Park and could be a source for colonization for butterflies in the Milk River-Lost River area (Smith and Bird 1977a; Pinel and Kondla 1985). In the event of extirpation of Alberta populations, eventual recolonization from the Sweetgrass Hills or other extant Montana populations by dispersal up the Milk River, coulee systems, or landscape corridors is conceivable. However, many riparian habitats used by Weidemeyer's Admiral in Montana are under pressure from invasive shrubs and their future suitability as dispersal corridors is threatened (see below).

THREATS AND LIMITING FACTORS

The primary limiting factor for the Weidemeyer's Admiral is the naturally patchy distribution of shrubby habitats in a matrix of short-grass prairie, badlands, and cultivated croplands (Kondla 2005). Prior to European settlement, Weidemeyer's Admiral populations were likely limited by predation, parasitoids, and incidental mortality of immature stages through browsing and trampling by bison and deer, burning of treed and shrubby patches, and intense weather phenomena such as hailstorms (Kondla 2005).

Invasive non-native species may represent a significant threat to riparian vegetation and Weidemeyer's Admiral habitat along the Milk River and Lost River valleys. The highly invasive Russian Olive has spread throughout riparian areas in Montana since its introduction in the 1950s (Olson and Knopf 1986), especially on regulated rivers (Lesica and Miles 1999) such as the Milk River. Russian Olive was introduced to the floodplain at the Aageson Ranch, 10 km downstream from the Alberta/Montana border in 1950 (Pearce and Smith 2009). Russian Olive seeds are dispersed by fluvial process as well as wildlife, and so Russian Olive density is much higher downstream of the ranch (40-300 trees/km) compared to upstream reaches, and most Canadian plants are within 2 km of the border (Pearce and Smith 2001, 2009). In 1999, almost 50 years after the initial introduction, only 84 plants were found in Canada, compared to orders of magnitude downstream (Pierce and Smith 2009).

Once established, Russian Olive is expensive to control and difficult to eradicate (Olson and Knopf 1986). Canadian suppression efforts along the Milk River began in 1999 and consisted of cutting trees and saplings and stump-spraying with Garlon. (Hood pers. comm. 2012). Phase 1 treated the area between Pinhorn Grazing Reserve and the southwest corner of the Lost River Ranch. In 2001, Phase 2 continued along the north side of the Milk River from Lost River Ranch to the international border. Areas along the south side of the Milk River still require treatment, particularly towards the international boundary and original introduction site, where Russian Olive densities are expected to be higher. Phase 3, planned for 2011 but not carried out due to lack of resources, was to treat a portion of this, with Phase 4 to complete the rest. Difficulty of access hinders both pre-treatment surveys and control efforts in these areas (Hood pers. comm. 2012). In 2005, Pearce and Smith (2009) resampled areas that had been treated during Phase 2. They found vigorous re-sprouting from treated stumps as well as 286 new plants. So, although the spread upstream into Canada has been relatively slow, once established it appears it will be difficult if not impossible to eradicate Russian Olive along the Milk River. The effects have been minor to date in Canada, but Russian Olive is changing riparian vegetation communities with significant negative effects on Cottonwood along downstream portions of the Milk River (Pearce and Smith 2001).

Saltcedar or Tamarisk is another non-native invader that is spreading at rates up to 15-20 km/yr along rivers in the arid American west, including Montana (Pearce and Smith 2003, 2007). It has not yet been found in Canada along the Milk River (Hood pers. comm.2012), but it is spreading from Havre, Montana approximately 80 km downstream (Pearce pers. comm. 2012). Tamarisk is almost impossible to eradicate once established, alters hydrological regimes, and displaces native plants (Zavaleta 2000). The significance of the impacts of Russian Olive and Saltcedar, or their control methods, on Weidemeyer's Admiral habitat or larval food plants to date is currently unknown. At present, these invasives are considered to be potential threats, unlikely to significantly impact Weidemeyer's Admiral within ten years, but once established in the butterfly's habitat they could have a rapid and highly detrimental impact (Gould, pers. comm.. 2012).

Livestock grazing at high levels of intensity throughout admiral habitat could be a potential threat. Livestock can inadvertently ingest or dislodge and trample larvae while browsing, and browsing can also reduce recruitment and health of larval host plants (Kondla 2005). However, cattle ranching has occurred in the area for about 100 years, and Weidemeyer's Admiral populations have persisted despite unregulated grazing intensities in the past (Kondla 2005). Livestock numbers in much of known Weidemeyer's Admiral habitat are currently regulated through grazing leases for Writing-On-Stone P.P., Onefour Heritage Rangeland N.A., and Pinhorn Grazing Reserve. Small water impoundments constructed for livestock watering may have had very localized negative impacts on habitat from trampling.

Most admiral habitat patches are not physically capable of supporting mechanized agricultural tillage, so farming is not a direct threat (Kondla 2005). However, the Milk River is an important water resource for many of the farmers, ranchers, and communities in southeastern Alberta and the lower Milk River has been considered for dam construction and reservoir formation (Alberta Environment 2002). There is no dam proposal at this time (TMRFSRRT 2008; see therein for more discussion of water issues), and reservoirs are not considered currently viable when weighted against economic, environmental, and political criteria (Elliot 2007). Although there is no imminent threat, there will likely be increasing pressure on water resources in southern Alberta with global warming (Sauchyn and Kulshreshtha 2008). If the Milk River valley were to be flooded, the breeding habitat on the valley bottom would be destroyed, but other breeding habitat higher up in ravines and coulees would be less affected (Kondla 2005).

Over the long term, global warming might impact Weidemeyer's Admiral populations in Canada in several ways. Although multi-year droughts can reduce the quantity and quality of larval food resources as well as nectar and moisture resources for adults (Kondla 2005), droughts in the last 1000 years have been more frequent and of greater magnitude than recent ones (Lemmen and Vance 1999; Khandekar 2004), and the species has persisted. Under a global warming scenario, the area with suitable climate and habitat for Weidemeyer's Admiral might expand in Canada, if prairie vegetation zones shift northward as predicted (Vandall *et al.* 2006). Global warming might also affect the fire cycle within the species' range in Canada (Sauchyn and Kulshreshtha 2008). However, only very large-scale fires could result in a significant reduction in habitat, which is unlikely because most fires are now quickly suppressed to protect buildings, crops and livestock forage.

Limited areas of admiral habitat could be destroyed through pipeline construction and related infrastructure, but it is unlikely to be sufficiently pervasive to have a measurable impact on total admiral numbers (Kondla 2005). Route planning would typically avoid the rugged topography typical of the river valleys and coulees used by Weidemeyer's Admiral.

Because the human population is sparse, urbanization is not a factor in this remote area of the Canadian prairie, and recreational use is likely to remain benign in relation to admiral habitat.

Collection of specimens requires a permit under provincial and federal laws. Illegal collecting in Canada is unlikely because the species can be collected legally elsewhere in its range where it is abundant.

PROTECTION, STATUS, AND RANKS

Legal Protection and Status

In Canada, Weidemeyer's Admiral is legally listed as *Special Concern* in Schedule 1 of the federal *Species At Risk Act*. It is also listed as *May be at Risk* (equivalent of *Special Concern*) under Alberta's Wildlife Act (Government of Alberta 2010). Weidemeyer's Admiral has no legal protection in the United States federally or at the state level.

Non-Legal Status and Ranks

Weidemeyer's Admiral is ranked as S1 (critically imperiled) in Alberta (ACIMS 2010) and G5 (secure) globally by NatureServe (2010). It is also ranked S1 in California, but is not included on the Special Animals list, although 40 other Lepidoptera taxa are tracked on this list (CA DFG 2009). In Nebraska, where it is also near the periphery of its range, it is ranked as S3 (vulnerable). The *L. w. nevadae* subspecies is listed as S2S3 in Nevada (NNHP 2010). Weidemeyer's Admiral is listed as S5 (secure) in Montana and Colorado, but is unranked (SNR) or under review (SU) in the remaining 12 of the 16 states within its global range (Table 1).

In the National General Status program (i.e., Wild Species 2010), Weidemeyer's Admiral has been assigned a rank of *May be at Risk* (equivalent to *Special Concern*) for Alberta and Canada, and assessed as a vagrant in Ontario (CESCC 2012).

Habitat Protection and Ownership

The Weidemeyer's Admiral population at Police Coulee is within Writing-On-Stone Provincial Park (2590 ha). Another known population is protected within a 3900 ha block of the Onefour Heritage Rangeland Natural Area along the Lost River.

Most of the remaining suitable habitat exists on provincial crown land that is leased to ranchers for cattle grazing, mainly within the 31,013 ha Pinhorn Grazing Reserve. These grazing leases are administered by Alberta Sustainable Resource Development (ASRD). Land under grazing leases may not be 'broken' for agriculture, and ASRD monitors the rangeland condition to ensure maintenance of productivity and other environmental values that are considered in management plans (ASRD 2010). Recreational activities as well as oil and gas exploration are allowed on the Pinhorn Grazing Reserve.

Several of the known sites are at least partially on private land and landowner co-operation will be needed to accommodate habitat needs for Weidemeyer's Admiral on these private lands. Beneficial management practices (RCS Ltd. 2004) have been developed as part of the Multi-Species Conservation Strategy for Species At Risk in the Milk River Basin (MULTISAR).

Suitable habitat is also present in both the Kennedy Coulee Ecological Reserve (1068 ha), the adjacent Milk River Natural Area (5550 ha), and a contiguous 2690 ha block of the Onefour Heritage Rangeland Natural Area. Additional surveys are required to determine if Weidemeyer's Admiral is present in these protected areas.

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Robert Foster is co-founder and principal of Northern Bioscience, an ecological consulting firm offering professional consulting services supporting ecosystem management, planning, and research. Dr. Foster has a B.Sc. in Biology from Lakehead University and a D. Phil in Zoology from the University of Oxford. Rob has worked as an ecologist in Ontario for over 15 years, and has authored or coauthored COSEWIC status reports on the Bogbean Buckmoth, Laura's Clubtail, Rapids Clubtail, Northern Barrens Tiger Beetle, and Drooping Trillium, as well as recovery plans for rare plants, lichens, and odonates.

Allan Harris is a biologist with over 20 years' experience in northern Ontario. He has a B.Sc. in Wildlife Biology from the University of Guelph and a M.Sc. in Biology from Lakehead University. After spending seven years as a biologist with Ontario Ministry of Natural Resources, he co-founded Northern Bioscience, an ecological consulting company based in Thunder Bay, Ontario. Al has authored or coauthored dozens of scientific papers, technical reports, and popular articles, including COSEWIC status reports for Bogbean Buckmoth, Laura's Clubtail, Rapids Clubtail, Northern Barrens Tiger Beetle, and Drooping Trillium and Small-flowered Lipocarpha. Al also authored the Ontario provincial status report for woodland caribou, and has authored or coauthored national and provincial recovery strategies for vascular plants and birds.

COLLECTIONS EXAMINED

S. Juneja provided data for the four Canadian specimens (including the Geddes specimen) held at the Canadian National Collection of Insects, Arachnids, and Nematodes (CNC) in Ottawa. John Swann provided data for nine Canadian specimens held at the University of Calgary (Lost River, Writing-On-Stone P.P.), and Jonathan Pelham confirmed locality data from the Washington specimen (Yale Peabody Museum). An online search of the E.H. Strickland Entomological Museum at the University of Alberta (UASM) yielded one specimen from Montana (Crazy Mountains, 16km NE of Clyde Park). Specimens from Alberta are also held by the two private collections of N.G. Kondla and E. M. Pike, both in Calgary, Alberta.

Appendix 1. Calculation of Canadian Extent of Occurrence and Area of Occupancy.

This appendix contains sensitive information that has been removed from the status report. This information may be obtained by contacting the COSEWIC Secretariat.

Appendix 2. Supporting data for Alberta Conservation Information Management System (ACIMS) element occurrence polygons for Weidemeyer's Admiral. See Appendix 1 and 3 for locations.

This appendix contains sensitive information that has been removed from the status report. This information may be obtained by contacting the COSEWIC Secretariat.

Appendix 3. Alberta Conservation Information Management System (ACIMS) element occurrence polygons for Weidemeyer's Admiral (red line) overlain on National Topographic Series 1:50,000 maps. See Appendix 2 for general locations.

This appendix contains sensitive information that has been removed from the status report. This information may be obtained by contacting the COSEWIC Secretariat.